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Maine Department of Transportation

# Transportation Research Division

## Technical Report 00-18

*Longitudinal Joint Treatment*

*Final Report - March 2006*

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*Longitudinal Joint Treatment*

## Introduction

Maine highways have been showing signs of longitudinal joint failure for a number of years. In an effort to reduce the amount of joint failures the Maine Department of Transportation (MDOT) is currently evaluating two projects. One project is monitoring the results of using multiple rolling techniques and a proprietary precompaction device. The other project involves developing a longitudinal joint density specification for Superpave mixes.

This experimental project will evaluate the application of a joint sealer and joint adhesive in an effort to reduce the amount of longitudinal joint separation.

## Project Location/Scope

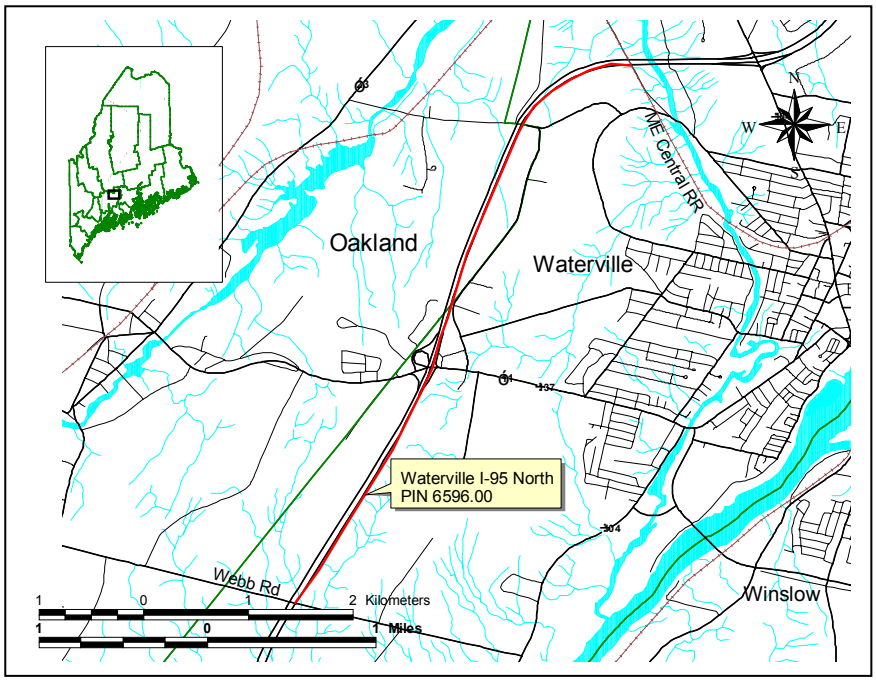


FIGURE 1. PROJECT LOCATION MAP

Project number IM-95-6596(00)E, Project Identification Number (PIN) 6596.00, was selected to apply joint sealer and adhesive. This project is located on the northbound lane of I-95 in the town of Waterville. The project begins at Webb Road Bridge station 196+780 and extends northerly 6.26 km to the Maine Central Railroad Bridge station 203+038 (see attached map). This is a pavement rehabilitation project which consists of milling 40 mm of existing pavement then paving with an intermediate course of 40 mm of 12.5 mm Superpave mix and 35 mm of 9.5 mm Superpave surface mix. The experimental area begins at station 196+780 and ends at station 200+370.

## Product Description

Three products were used to seal the longitudinal joints.

The first is a rubberized joint sealer labeled CMC #102 manufactured by Crackfiller Manufacturing Corporation. A Product Data Sheet containing a description and physical properties of the product is displayed in Figure 2.

PRODUCT DATA SHEET — CRACK & JOINT SEALANTS

# CMC #102

## ASTM D-3405-78

### REQUIREMENTS

Single component hot applied crack sealant. Exceeds the requirements of ASTM D-3405. Typical uses are for roads and highways.

### GENERAL COMPOSITION

Ingredients include a mixture of virgin synthetic rubber or reclaimed rubber or a combination of the two with asphalt and other modifiers as required to meet the specification. **Reclaimed materials** are utilized as needed except when prohibited by the specifying agency or if use would adversely affect product quality or compliance to specification. Compatibility with surface treatments should be confirmed by the user through field testing prior to application.

### USE

CMC 102 is a pre-reacted sealant and can be applied immediately after application temperature is reached. Specification requires sealant to be heated in a Melter utilizing oil as a heat transfer medium. The Melter shall be capable of constant agitation and equipped with a calibrated thermometer. Application can be by hand-held or wheeled pour pots or use of a pressure applicator.

### APPLICATION

Heating and application in accordance with manufacturer's detailed instructions.

### PHYSICAL PROPERTIES & SPECIFICATION COMPLIANCE

| TEST | TEST METHOD | SPECIFICATION | TYPICAL RESULTS |
|---|---|---|---|
| Cone pen @ 77°F(25°C) | ASTM D-3407 | 90 max. | 75-85 |
| Resilience | ASTM D-3407 | 60% min. | 65% |
| Bond @ 0°F(-18°C), 100% ext. | ASTM D-3407 | Pass 3 cycles | Pass 3 cycles |
| Bond @ -20°F(-29°C), 50% ext. | ASTM D-3407 | Pass 3 cycles | Pass 3 cycles |
| Flow @ 140°F(60°C) | ASTM D-3407 | 3 mm max. | 1-2 mm |
| Asphalt compatibility | ASTM D-3407 | Complete | Pass |
| Safe heating temperature | | 400°F(206°C) | 410°F(212°C) |
| Recommended application temp. | | | 380°F(195°C) |
| Maximum application temperature | | | 390°F(200°C)** |

** *Temperature of sealant measured at pavement surface. Use Maximum application temperature in cool weather.*

### PACKAGING

Available in a 30 lb (13.6 kg) box, 75 boxes per pallet. Pallets weigh approximately 2,250 lbs (1,020 kgs). Alternate packaging is available

### WARRANTY

CMC warrants that all sealant meets applicable specifications at time of shipment. Remedies against CMC are limited, at CMC's option, to product replacement, or full or partial refund, and does not include installation or any other cost. Claims must be made within three months of the date of purchase.

Effective 1-1-94

Distributed in your area by:

**J A M B R O, INC.**
261 Southwest Cutoff (Rte. 20)
WORCESTER, MASSACHUSETTS 01604
**PH 800-249-2722 (508) 767-1000**
**Fax (508) 767-1002**

**Crackfiller Manufacturing Corporation**
PO BOX 6738 CHEYENNE, WY 82003 307/778-8610

FIGURE 2. CMC #102 PRODUCT DATA SHEET

The second product is a joint adhesive labeled KOCH PRODUCT #9005-HV manufactured and supplied by KOCH Materials Company. Figure 3 contains a Specification Conformance Sheet for this product.

KOCH

KOCH MATERIALS COMPANY

COATING & SEALANTS DIVISION

July 23, 1999
Jambro, Inc.
265 Southwest Cutoff (Rt. 20)
Worcester, MA 01604

**PRODUCT : KOCH PRODUCT #9005-HV**
**REFERENCE: MAINE D.O.T.**

*SPECIFICATION CONFORMANCE:*

| Tests: | Crafco Requirements: | Koch Typical Results: |
|---|---|---|
| Brookfield Viscosity, 400°F | 4,000 - 10,000 cps | 9,500 cps |
| Softening Point | 170° F Minimum | 195° F |
| Cone Penetration @ 77° F (25° C) | 60-100 | 75 |
| Flow @ 140° F (60° C) | 5.0 Maximum | Pass |
| Resilience, 77° F | 30% Minimum | 70% |
| Ductility, 77° F | 30 cm Minimum | 50 cm |
| Ductility, 39.2° F | 30 cm Minimum | 40 cm |
| Tensile Adhesion, 77° F | 500 % Minimum | 800% |
| Flexibility, 0° F | Pass | Pass |
| Asphalt Compatibility | No failure in adhesion formation of an oily exudate at the interface between the sealant and the block | Pass |
| Safe Heating Temperature | 410°° F | 390 °F |
| Recommended Pouring Temp. | 380° F | 370° F |
| Unit Weight @ 60° F | 9.3 Lbs. per Gallon | 9.3 Lbs. per Gallon |

As indicated by the foregoing test results, Koch Product #9005-HV, a high-quality hot-applied joint sealant, complies and exceeds the Specification Requirements of Crafco Pavement Joint Adhesive. Koch #9005-HV also meets the Specification Requirements of ASTM D 3405, ASHTO M-173 and Federal Specification SS-S-1401C.

Very truly yours,

David Bealer

David Bealer
Quality Control Manager

P.O. Box 191 • Northumberland, Pennsylvania 17857-0191 • 800/521-9593

FIGURE 3. KOCH PRODUCT #9005-HV SPECIFICATION CONFORMANCE SHEET

The third product, which is a standard joint sealer for most projects and will be used as a control section for this study, is an emulsified asphalt grade HFMS-1.

## Construction

The centerline longitudinal joints were constructed at 75 mm offsets between the intermediate and surface course. The same product was used to seal both the intermediate and wearing course in each section. The following Special Provision was included in the Project Bid Package.

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**SPECIAL PROVISION**
**SECTION 424**
**JOINT SEALER**

**Description.** This work shall consist of furnishing all labor, equipment and materials necessary to clean and seal longitudinal and transverse joints that result in the construction of bituminous concrete pavement courses. This material is to be thoroughly applied to the joints during the construction of bituminous pavement courses, to seal the construction joint from deterioration due to the elements, and to adhere the joint materials together.

**MATERIALS**

**General.** Pavement joint adhesive shall be a hot applied modified asphalt designed to seal and adhere the cold longitudinal construction joints to adjacent courses. The specified material shall be a Pavement Joint Adhesive manufactured by Craftco Inc., or a verifiable equivalent.

The emulsion shall conform to the applicable provisions of Section 409 Bituminous Tack Coat and to the requirements of Section 700 of the Standard Specifications.

Asphalt rubber crack sealer shall be an asphalt and rubber compound designed for sealing and improving the strength and performance of the base asphalt cement and shall conform to ASTM D 3405.

**CONSTRUCTION REQUIREMENTS**

**Weather.** Asphalt rubber crack sealer, pavement joint adhesive, and emulsion shall not be applied on a wet surface, after sunset or before sunrise, or when the atmospheric temperature is below 10°C in a shaded area at the job site, or when weather conditions are otherwise unfavorable to proper construction procedures. An atmospheric temperature of 2°C and rising will be permitted on intermediate and base courses, with the time and weather constraints remaining.

**Preparation and Placement.** This work shall include three 1000 meter test sections, beginning at the construction joint at the Webb Road Bridge. The first section shall be constructed with a pavement joint adhesive that conforms to ASTM D - 3405. The second test section shall be constructed with an HFMS - 1 emulsion (tack) meeting 409.15 requirements. The third section and remaining project length will be constructed using a rubberized sealer that conforms to ASTM D - 3405.

Asphalt rubber sealer and pavement joint adhesive shall be heated and applied at a temperature between 170°C  200°C or as specified by the manufacturer and approved by the Construction Manager. Sealer shall be delivered to the crack through a pressure hose line and applicator shoe. The shoe width and the sealer overbanding area shall vary from 35mm to 40mm depending on the joint height variability. These

materials will not be applied at no more than 12hrs prior to the placement of any pavement course. Emulsions shall be heated and applied in accordance with the applicable provisions of Section 409 Bituminous Tack Coat.

**Preparations of Joints.** All joints shall be swept or blown free of loose material, dirt, vegetation, and other debris. Material removed from the joint shall be removed from the pavement surface by means of a power sweeper or appropriate hand tools as required. Joints shall be additionally cleaned by appropriate hand tools if contaminants remain on the face. All debris, vegetation, and water shall be removed to enhance adhesion of the crack sealing material.
**THIS WORK SHALL NOT BE DONE IN INCLEMENT WEATHER.**

**Equipment.** Equipment used in the performance of the work shall be subject to the Construction Manager's approval and shall be maintained in a satisfactory working condition at all times.

(a) Sweeper: The sweeper shall be a manually operated, gas powered air broom, or self propelled sweeper designed especially for use in cleaning pavements shall be used to remove all debris, dirt, and dust from the joints.

(b) Hand Tools: Hand tools shall consist of brooms, shovels and any other tools which may be satisfactorily used to accomplish this work.

(c) Melting Kettle: The unit used to melt the joint sealing compound shall be a double boiler, indirect fired type. The space between inner and outer shells shall be filled with a suitable heat transfer oil or substitute having a flash point of not less than 320°C. The kettle shall be equipped with a satisfactory means of agitating and mixing the joint sealer at all times. This may be accomplished by continuous stirring with mechanically operated paddles and /or a continuous circulating gear pump attached to the heating unit. The kettle must be equipped with thermostatic control calibrated between 94°C and 290°C.

**Workmanship.** All workmanship shall be of the highest quality. Excess sealer shall be removed from the pavement by approved methods and discarded. Any workmanship determined to be below normal acceptable standards will not be accepted, and will be corrected and/or replaced as directed by the Construction Manager.

**Method of Measurement.** Asphalt rubber sealer and pavement joint adhesive will be measured by the linear meter applied.

**Basis of Payment.** The accepted quantity of asphalt rubber sealer and pavement joint adhesive will be paid for at the contract unit price per linear meter complete in place, which price shall be full compensation for furnishing and placing sealer or adhesive, including all cleaning of joints, and furnishing and placing all materials necessary to perform the work.
There will be no separate payment for furnishing and applying HFMS 1 emulsion; this work will be considered incidental to the pavement items in the contract.

Payment will be made under:

| **Pay Item** | | **Pay Unit** |
|---|---|---|
| 424.36 | Asphalt Rubber Joint Adhesive, Applied | linear meter |
| 424.321 | Asphalt Rubber Crack Sealer, Applied | linear meter |

Section I utilizes the joint sealant CMC #102. This section begins at Webb Road Bridge at station 196+780 and ends at station 197+780. The travel lane was paved with intermediate course mix in the direction of travel; next the centerline longitudinal joint was sealed with CMC #102 then the passing lane was paved. A crew of three people applied the sealant using a handheld wand with a shoe attachment on the end in the shape of an inverted L. The sealant was heated and pumped thru the wand to the shoe that was dragged along the joint spreading sealant along the face. The CMC #102 joint sealant had a rubbery appearance and slowly flowed down covering most of the joint face but leaving a few gaps in the coverage. When the operator slowed the application rate to cover more of the joint face an undesirable amount of the product would settle on the bottom of the joint. The wearing course was paved and sealed in the same sequence as the intermediate course. Both the intermediate and wearing course joints for this section were sealed at a rate of 0.13 kg/m at 190º C. Figure 4 contains a typical cross section.

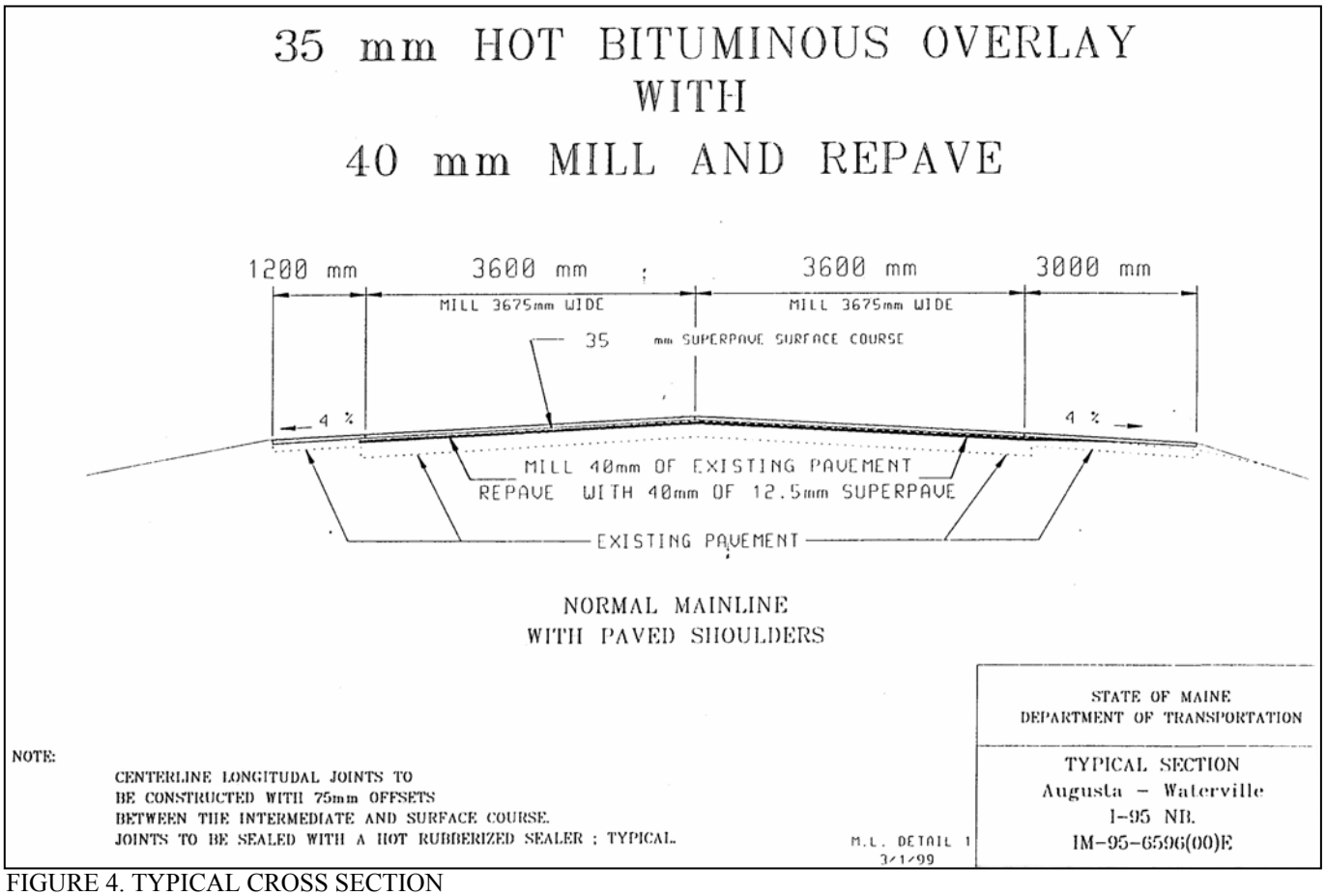

FIGURE 4. TYPICAL CROSS SECTION

Section II longitudinal joint was sealed with emulsified asphalt grade HFMS-1. This section begins and ends at stations 197+780 and 198+785 respectively. This section was paved in the same sequence as Section I. The emulsified asphalt was applied with a handheld spray bar covering a large portion of the top, face and bottom of the joint in a uniform layer leaving few exposed surfaces. The application rate and temperature are not available.

Section III was sealed with KOCH PRODUCT #9005-HV joint adhesive. This section begins at the North abutment of the Kennedy Memorial Bridge at station 199+370 and ends at station 200+370. This section was also paved in the same sequence as Section I. The same heater and wand used to apply sealant on Section I was used to apply joint adhesive on this section. The KOCH #9005-HV joint adhesive had a granular appearance and was more fluid than the CMC #102 allowing the product to cover slightly more

of the joint face than in Section I. Once again the application rate had to be steady to avoid adhesive settling at the bottom of the joint. The rate of application was 0.18 kg/m at a temperature of 190º C.

## Visual Evaluation

The fifth and final scheduled visual evaluation was completed on September 1, 2004. Additionally, permeability testing was performed at several locations in each of the three sections. These tests were completed using an apparatus manufactured by Worster Polytechnic Institute (WPI) staff (see Photo 1 below). That staff also performed the testing. Although reporting of the test results was very limited, no water loss, a key gauge in permeability testing, was recorded at any of the test locations.

Findings from the visual evaluation are detailed below.

Photo 1 – Permeability Apparatus

**Section I – CMC #102**

Joint separation at the beginning of Section I increased minimally from the16 meters (52 feet) reported in the Fourth Interim report, to 18 meters (59 feet). This area showed signs of joint separation and ravel as early as one year after construction. It is speculated that joint deformation in this area is a result of poor construction rather than joint sealant failure. This deformation is pictured in Photo 2 below. Only 1 meter (3 feet) of additional joint separation was identified throughout this section. Overall, joint condition is very good. A typical portion of Section I is pictured in Photo 3.

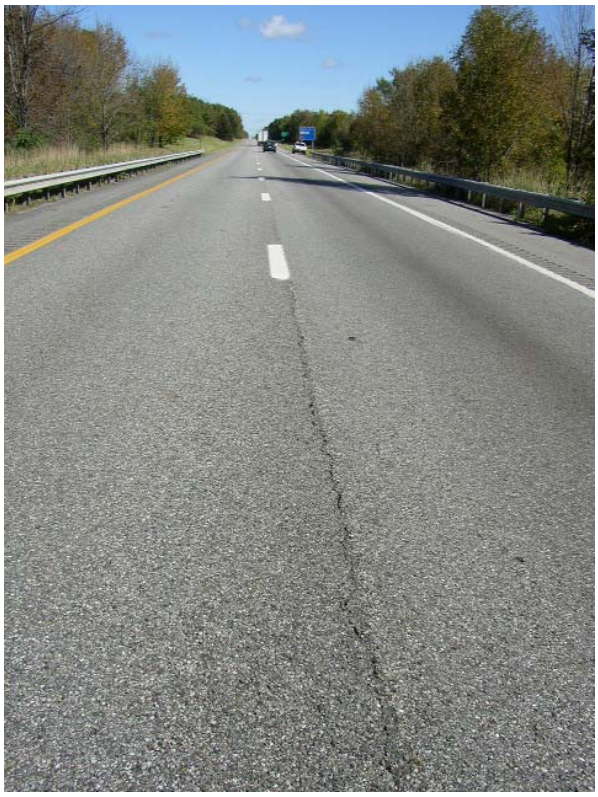

Photo 2: Joint separation and ravel.

Photo 3: Section I typical joint condition

**Section II – Emulsified Asphalt (HFMS-1)**

The Section II centerline joint remains in very good condition with only 5 meters (16 feet) of joint separation identified. No separation was reported in the Fourth Interim for this section. Photo 4 displays a typical portion of the Section II centerline joint.

**Section III – KOCH #9005-HV**

As is the case for Section I, Section III begins at a bridge abutment and is displaying similar joint separation. Centerline joint separation located near the abutment increased from 10 meters (33 feet) reported in the Fourth Interim, to 13 meters (43 feet). Like Section I, this separation and raveling appears to be construction related. Photo 5 is a view of the joint separation taken from the bridge abutment. Only 4 meters (13 feet) of additional joint separation was identified along this section.

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Photo 4: Section II typical joint condition

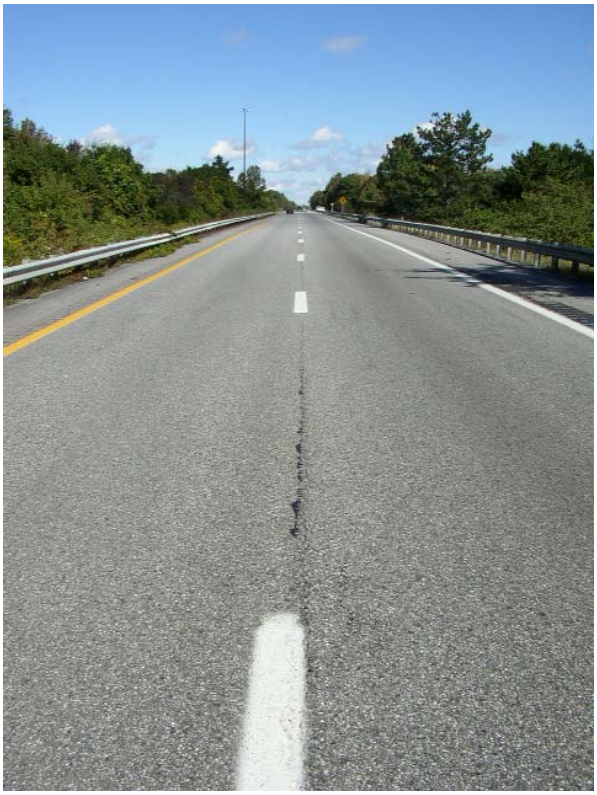

Photo 5: Section III joint separation and raveling.

## Conclusions

Overall, centerline joints are performing very well in each of the three sections. Excluding the 18 meters (59 feet) at the start of Section I and the 13 meters (43 feet) at the beginning of Section III that were considered to be construction related failures, a very small portion of the centerline joint has separated. Whereas such a small amount of separation occurred in each of the three sections, no discernable differences can readily be identified with respect to performance. Based on the visual evaluations conducted as part of this limited comparison, there appears to be no distinct advantage to using any of the three products applied.

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Other Available Documents:
Construction Report, May 2000
Interim Report - First Year, November 2000
Interim Report - Second Year, September 2001
Interim Report - Third Year, March 2004
Interim Report – Fourth Year, March 2005

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